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THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

By Dr. N. H. HECK

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IN times when there is a tendency to the nationalization of science it is well to realize that there are earth sciences relating to the physics of the earth as a whole —geophysics—which know no national boundaries. Though there are a number of international organizations which deal with these earth sciences from various view-points, there is only one which brings them together and treats them from the view-point of the world as a whole. This is the International Union of Geodesy and Geophysics, which has been in existence since 1919 and which grew out of other organizations which came into existence as early as 1862. This union is made possible through financial support from a large number of countries now numbering 37. In most cases the adhering body is not the government but the national committee on geophysics.

In the case of the United States the situation is somewhat complicated. The National Research Council is the adhering body, but the national committee on geophysics is the American Geophysical Union. The latter as a whole is not part of the National Research Council, but its executive committee, made up of officers, chairmen of certain standing committees and certain ex-officio members from the Research Council itself, constitutes the Committee on Geophysics of the National Research Council.

The International Union of Geodesy and Geophysics is composed of seven associations, which are autonomous in scientific matters. These relate to geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, volcanology and scientific hydrology.

The American Geophysical Union is the American branch of the International Union. It has seven sec-

tions and each is a branch of the corresponding association. This dual relationship is very important in the functioning of the respective bodies. The unions themselves deal principally with administration, while the sections and associations are chiefly concerned with scientific matters. There are also in both the national and international unions a number of commissions which deal with subjects related to two or more of the branches. There is an absence of system in the use of the term committee and commission, and for convenience those of a single branch will be called committees and those related to several branches commissions, though this does not exactly conform to practise. It must be remembered that in French, the language of the official statutes, there is but a single word, "Commission."

The International Union must necessarily have close relations with other international organizations, but this can best be brought out in connection with the discussion of the individual associations.

The idea of a union grew out of the international associations in two of the fields which existed before and up to the world war. The Association of Geodesy was formed in Germany in 1862 and continued up to the war with a maximum of 19 adhering nations. As early as 1877 Charles Sanders Peirce attended a conference at Stuttgart, even though the United States had not then adhered. The first official American representative was Cutts in 1886, and later such well-known geodesists as Davidson, Schott, Tittman, Hayford and Bowie, all of the Coast and Geodetic Survey, attended meetings. The Association of Seismology was formed in Germany in 1903 and had as a maximum 23 adhering nations. A number of meetings were attended by Reid, of Johns Hopkins University. Accordingly there has been a long established tradition of American attendance. It should be stated that some of the other associations had their roots in the past, in the case of terrestrial magnetism and electricity as early as 1845, but there was no continuing independent organization.

After the organization of the union in Brussels in 1919, the first general assembly was held in Rome in 1922, the next in Madrid in 1924 and thereafter at three-year intervals in Prague, Stockholm, Lisbon and Edinburgh. At all there has been a large American attendance. At Edinburgh there were 33 delegates and 17 guests from this country. For the meeting in 1939, the National Research Council authorized the American Geophysical Union to extend at Edinburgh an invitation to hold the meeting in Washington, D. C. The invitation was cordially accepted, and the meeting is scheduled for early September of that year.

In this connection some of the precedents established at earlier meetings are of interest. Heads of governments have presided at a general assembly or have given receptions. These have included the King of Italy, the former King Alfonso of Spain, the Crown Prince of Sweden and the President of Portugal. The honorary committees have invariably consisted of high officials and the heads of related scientific organizations. The meetings usually last for ten days, and for some of the associations and commissions there are additional sessions before the first general assembly.

The International Union of Geodesy and Geophysics was established at Brussels in 1919 under the auspices of the International Research Council (now the International Council of Scientific Unions) together with other International Unions of Astronomy, Mathematics, Chemistry and Scientific Radio-telegraphy. The convention governing the union lasted ten years, but by 1932 these had been revised to meet changed conditions.

While the majority of the adhering countries are in Europe, there are members from all parts of the earth, the present number being 37. In the Americas, Canada and a number of the Latin American countries adhere.

The objects of the union as set forth in its statutes are: (1) to promote the study of problems relating to the figure and physics of the earth; (2) to initiate and coordinate research which depends on cooperation between different countries and to provide for its scientific discussion and publication; (3) to facilitate particular research such as the comparison of instruments and standards used in different countries. Most countries make reports of their activities in geophysical fields, thus providing a useful history of accomplishment.

The ultimate aim is to foster, through encouragement and assistance, the acquisition of scientific facts regarding the earth, which could not be acquired without cooperative effort.

In addition to the essential administrative and scientific deliberations, no small importance attaches to the establishment of personal contacts which lead to better understanding and more effective cooperation. Opportunity for such contacts is afforded by receptions, social events and trips during and before and after the scientific meetings. Such trips as those provided in Sweden to the north and south of that country and in Portugal to the famous vineyard country and many other places, have given opportunity not only to become better acquainted but to learn at first hand the interesting features of the countries visited.

Association of Geodesy

Since this is the only association which may be said to have had a continuous existence in some form in spite of the war, additional history is of special inter-

...st. The last meeting of the old association was held ...n Hamburg in 1912. When the war came the organi...ation was continued under the name of "Reduced ...eodetic Association among Neutral States" by eight ...eutral countries, including the United States, which ...ithdrew when it entered the war. When the Inter...national Union was formed, the Reduced Association ...levoted its remaining assets to publishing the results ...f the International Latitude Service and became ...merged in the new Association of Geodesy.

The association deals with certain questions as a whole, but its main work is done by nineteen committees on such subjects as triangulation, leveling, gravity, etc., twelve of which relate to the earth as a whole or large areas, while the rest relate to specific regions. Some of the more important committees work jointly with the International Astronomical Union and relate to variation of latitude, world longitude net and international time service.

Among the accomplishments have been the encouraging of the gravimetric work at sea of Vening Meinesz, who is now president of the association, and of others using the apparatus which he developed and influencing individual nations to continue the international observatories for the study of variations in latitude. Two of these are in the United States, respectively at Gaithersburg, Maryland, and Ukiah, California. The International Association was unable to find funds for continuance of the various observatories, but all are still in operation. The World Longitude Net with observations in 1926 at 50 stations and in 1933 at 90 also has a geological significance. The Wegener hypothesis of drifting continents has aroused both strong support and violent objection, but the most direct test is to find whether changes in longtitude occur with time, and this can be accomplished only by well-organized special radio determinations.

The principal publications are a quarterly geodetic bulletin, triennial national and special reports, a bibliography and special publications.

Association of Seismology

The old Association of Seismology was inactive during the war, since much of the earlier initiative came from the Central Powers. However, it was at least ten years after the war before its affairs were liquidated. The new organization has had its Central Bureau at Strasbourg under the direction of its secretary, Rothé. The association's functions relate to the location of earthquakes through the interpretations from all seismological observatories, lists of these observatories, securing international agreement on nomenclature and other questions and support of researches of broad character which would otherwise remain undone.

An important activity is partial financial support of the International Seismological Summary, started at Oxford University through the initiative of the Seismological Committee of the British Association for the Advancement of Science. As conditions have changed and especially with the increase in the number of earthquakes that can be located as the result of better instruments, the needed support from the association has grown. At Strasbourg preliminary determinations of earthquake location are made. The publications include: (1) the reports of meetings and all papers presented and (2) a series of special publications in seismology, including the results of research supported by the association.

Association of Meteorology

The Association of Meteorology collaborates extensively with the International Meteorological Organization, which has long been in existence. The membership of the latter is made up of the directors of the official meteorological services of the different countries and selected members of their staffs. In the intervals between meetings the actions of the various commissions and subcommissions of the organization are cleared by the International Meteorological Commission, which is composed exclusively of a selected group of the directors of meteorological services. Since most of these directors are members of the Association of Meteorology, matters of common interest are referred from one organization to the other by informal and occasionally formal communication. This close relationship also makes the members of either group aware of needed action on the part of the other, whether it be in the matter of research work, observation, communication, administration, etc. The relation between the two groups is entirely harmonious and mutually beneficial. While some of the functions might seem to overlap, no serious difficulties are encountered and their work has been found to be mutually inspiring and helpful. The activities of the International Meteorological Organization are broader, since matters of administration and service as well as research are dealt with, whereas the work of the association is founded more particularly on investigation and research. The association also affords means of direct contact with members of other associations with related interests.

Association of Terrestrial Magnetism and Electricity

There was a Magnetic Congress at Cambridge, England, in 1845 under the auspices of the British Association for the Advancement of Science which was attended by Gauss, Lamont and others. Nothing further was done in the way of international organiza-

tion till about 1890, when the formation of an international association was considered. Instead of this, however, in 1891 the International Meteorological Organization organized a Commission of Terrestrial Magnetism and Atmospheric Electricity, which still exists. This came about because much of the work in terrestrial magnetism and associated fields is done in Europe by meteorological services.

Accordingly, when the Association of Terrestrial Magnetism and Electricity was formed, there was a similar problem to that of the Association of Meteorology, and it was solved in much the same manner. Among the members of the commission are many who belong to the association. Cooperation between the two bodies is most effective, and each supplements the work of the other. Certain publications, such as the Magnetic Character of Days (with reference to the degree of magnetic disturbance) are under the auspices of the Meteorological Organization as is also the Second Polar Year Commission (1932–1933), which is still actively engaged in the compilation and interpretation of results. The association deals with the many complex relationships of terrestrial magnetism and other phenomena, and it makes decisions about methods of publication of the results of observation and nomenclature.

The association takes a prominent part in encouraging magnetic surveys of all countries and of the oceans. Its special committees deal with such subjects as secular variation, solar activity and magnetism, magnetic standards and magnetic charts. It has two joint commissions, one with the International Meteorological Organization on methods and codes to describe magnetic storms and the other with the International Union of Radio Telegraphy in the study of the ionosphere.

Its publications include the *Bulletin* series with transactions of the triennial meetings, a quarterly publication on magnetic character of days based on daily ranges at certain observatories and special bulletins.

Association of Physical Oceanography

In no branch of the association's activity is international cooperation more necessary than in that relating to the sea, most of which is common to all nations and belongs to none. The Association of Physical Oceanography functions in much the same manner as the other associations, dealing primarily with those branches of oceanography in which mathematics, physics and chemistry are applied to a scientific study of the sea. Fifteen of the adhering countries have national committees on oceanography which are affiliated with the association.

At the meeting in Edinburgh, preliminary plans were discussed for an international survey of the Gulf Stream in which the research vessels of several nations bordering on the North Atlantic Ocean would participate. A number of committees were appointed to deal with various aspects of oceanography, such as the tide, chemical methods and nomenclature, preparation of standard water, the relation of meteorology to oceanography and gravity at sea.

Prior to 1930 scientific papers were not presented, but at Lisbon and Edinburgh papers dealing with a wide range of subjects in physical and chemical oceanography were presented.

The association is also affiliated with certain other organizations dealing with oceanography, such as the International Hydrographic Bureau, the International Council for the Exploration of the Sea and the International Commission on Oceanography of the Pacific.

Association of Volcanology

The activities of the Association of Volcanology are carried on by a small but active group of nations. The work deals not only with active volcanoes but with the results of earlier volcanic activity. The funds of the association support the *International Volcanological Bulletin* and special investigations in the regions of active volcanoes. The meeting at Edinburgh endorsed efforts to secure reports of submarine volcanic activity, gravimetric surveys in the vicinity of volcanoes and the study of luminous effects accompanying certain volcanic eruptions.

Association of Scientific Hydrology

The administrative work of this association is carried on by the elected officers and an executive committee, with members from each adhering country. Its scientific work is carried on through seven committees which relate to the following subjects: potamology (science of streams); limnology (science of lakes); snow; glaciers; statistical methods; and practical applications. Two committees, those on snow and underground waters, are headed by Americans (Church and Meinzer, respectively).

The two outstanding recent accomplishments of the association are the publication of an annual bibliography of hydrology and the work of the committee on snow. The last represents an outlook on the subject which extends beyond the adhering countries. At the Edinburgh meeting there was a three-day conference on snow and glaciers.

Commissions Relating to Two or More Associations

The Commission on Raz de Marees (unusual sea-waves) is supported by the Associations of Seismology, Oceanography, Meteorology and Volcanology. The commission publishes all available information in re-

gard to these phenomena and inaugurates studies in regard to them.

COMMISSION ON CONTINENTAL AND OCEANIC STRUCTURE

This commission is concerned with the study and exploration of the structure of the crust of the earth, especially through geophysical methods and techniques. Since a large part of the crust is covered by the sea, the commission is at present chiefly concerned with the promotion of the study of the suboceanic crust, which is possible only by geophysical methods. The ultimate aim is to make it possible for the geologist to compare what he learns in this way with what he thinks he has learned on land through the application of all available methods. The problem is too large for any private or public venture of any one nation, so the purpose of the commission is to encourage international cooperation. An American, Field, is president of this commission.

For the union as a whole and for associations, Americans have held presidencies as follows: Union, Bowie, 1933–36; Geodesy, Bowie, 1919–33; Terrestrial Magnetism and Electricity, Bauer, 1927–30, and Fleming, 1930–39; Seismology, Heck, 1936–39. Bauer was secretary of Magnetism, 1919–1927. Vice-presidencies have been held by seven Americans, and numerous others have served on executive and special committees.

The officers of the union for the Washington meeting will be D. LaCour, of Denmark, president, and H. St. J. Winterbotham, of Great Britain, secretary general. The Washington meeting will be similar to those held in Europe. During the ten days which it will last there will be at least two general assemblies, meetings of associations and their committees and of their joint commissions. These official duties will be interspersed with suitable entertainment and visits to the many activities related to geophysics as well as objects of more general interest in or near the National Capitol. Plans have been made for more extended trips before and after the meeting which would give an opportunity to see some of the extended geophysical activities of the country. At the proper time a complete announcement will appear in SCIENCE.

THE JUBILEE MEETING OF THE INDIAN SCIENCE CONGRESS

By Professor R. R. GATES
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THE invitation from the Indian Science Congress Association to over fifty British scientists as well as others from overseas and from foreign countries, to take part in the twenty-fifth session meeting at Calcutta, from January 3 to 9, led to a meeting which was unique in many features. The British party, numbering over a hundred in all, landed at Bombay on December 17. After two days of receptions, dinners, lectures and sightseeing, the party left by a special train in which the members lived during a long tour ending at Calcutta on January 2. A detour southward was made first to the native state of Hyderabad, where the party were guests of the Nizam. Two days were spent in the city of Hyderabad and surrounding country, where the Osmania Mohammedan University, still in process of construction, was visited. The Golconda fort, on a hill 400 feet high, is a grim medieval stronghold built to contain a large population. At Daulatabad another remarkable hill fort was seen, with passages hewn out of solid basalt. Seventeen miles from Aurangabad, the party proceeded by car to view the temples carved out of the basalt caves in the hillsides at Ellora, and farther to the north the beautiful colored frescoes in the Buddhist caves at Ajanta, dating from about 200 B.C. to 600 A.D.

The next stop, at Sanchi in Bhopal, was to see the collection of Buddhist stupas on a hilltop above the river Betwa. These are probably the oldest buildings in India, some dating from the time of Asoka in the third century B.C. They are still visited by pilgrims from China and Japan. In a day at Agra the Taj Mahal, the fort of Akbar, the palace and museum were seen. Delhi and vicinity, where Christmas was spent, contains endless monumental relics of the Mogul period, as well as the great government buildings of New Delhi and the Imperial Institute of Agricultural Research, where much work for Indian agriculture is being done.

Dehra Dun was next visited, where the Forest Research Institute is probably the largest of its kind in the world. Here can be seen a great display of Indian timbers (botany section) and the fungal (mycology section) and insect pests (entomology section). Also methods of testing timbers, as well as a utilization plant where such processes as paper-making from bamboo and the impregnation of whole logs with "ascu" as a preservative instead of creosote are carried out. A motor journey up the mountains to Mussoorie on a ridge at an altitude of 6,600 feet in the foothills of the Himalayas afforded a magnificent view of the plains below and the distant snowy range of the Himalayas to the northward.

At Sarnath, near Benares, are the relics of stupas which saw the beginnings of Buddhism in the sixth century B.C. Benares itself, one of the world's oldest cities, is studded with Hindu temples, and the four-mile stretch on the high north bank of the Ganges is a continuous panorama of oriental architecture, temples, shrines, mosques, bathing ghats and burning ghats—where pilgrims flock in thousands to bathe in the sacred waters. A special convocation of the Hindu University of Benares was held in a huge marquee, and a number of honorary degrees were conferred. The aim of this university, which was opened in 1921, is to combine the best of ancient Indian culture with the science and culture of the West.

Some members left the train at Calcutta, but the majority continued on to Darjeeling, nearly 400 miles northwards, where they obtained an exceptionally clear view of the mighty Himalayan peaks.

The week in Calcutta was crowded not only with scientific meetings held at various colleges of the university, but with many forms of hospitality, including dinners, luncheons, teas and garden parties. The session was formally inaugurated by His Excellency the Viceroy of India, who was accompanied by the governor of Bengal. The Science Congress is organized in thirteen sections, including the usual sciences and, as befits a tropical country, additional sections of entomology, medical and veterinary research.

The Proceedings, or abstracts of papers, fill a volume of 309 pages. The membership for the meeting was very large, but its numbers are somewhat indeterminate. An indication of the interest displayed by the general public may be obtained from the fact that a public lecture by Sir James Jeans was attended by 3,000 people, while thousands more clamored for admission. In addition to the program of papers, numerous lectures were given by members of the party at all the places visited.

An excellently illustrated handbook of the field sciences of India, edited by Dr. S. L. Hora, was issued to members, and overseas visitors received a useful guide-book to the places visited during the tour. The various sectional programs contained a number of discussions, especially in the biological sciences. To cite a few: the dissemination of cereal rusts in India; animal ecology in relation to India; blood groups and racial classification; nutritional diseases of India; the application of statistics to agriculture; discrepancies between the chronological testimony of fossil plants and animals; the absorption of salts by plants; the species concept in the light of cytology and genetics; river physics in India; colloids in biology, medicine and agriculture.

A special excursion down the river Hooghly to the Botanical Garden at Sibpur was held in connection with the celebration of the one hundred and fiftieth anniversary of the foundation of these gardens. The famous banyan tree in the gardens has now lost its central trunk and the basal portions of the horizontal spreading branches, through age, but the rest of the branches remain and continue their growth, held in place by the roots which descend to the soil. The Royal Asiatic Society of Bengal, the oldest scientific society in India, and Law's aviary were other places visited by many, as well as the Victorian Memorial, the Natural History Museum, which held a special exhibition of modern Indian painting, and the Bose Research Institute.

Following the meeting, the main party of delegates returned immediately by special train to Bombay *via* Southern India, stopping at Madras, Bangalore and Mysore. I was able to spend a month traveling through Southern India and Ceylon before sailing from Colombo. During this period as state guest in Mysore, Cochin and Travancore, many unforgettable sights were witnessed. The vegetation ranged from spiny scrub near Madras and elephant bamboo jungle and tea and rubber plantations in the Nilgiri Hills, to the lagoons, coconut groves and mangroves of the Malabar coast, the wind-swept sand dunes of Cape Comorin and the vicinity of Adam Strait and the luxuriant rain-forests of Ceylon.

The racial types of India are of equal interest, and the Deccan and Southern India in particular constitute a veritable anthropologists' paradise. No other part of the world is so rich in ethnic diversity. The un-Hinduized hill and jungle tribes of India are estimated to reach some 25,000,000 in numbers, but they are rapidly changing their customs and many are already becoming intermixed with civilized Indian types. This great field for investigation has only been touched by the anthropologists now available in India, though several of them are doing active work. The blood groups, in particular, of nearly all these tribes, of which there are 40 or so in Travancore alone, remain to be tested.

The Kurubas in the elephant jungles of Mysore were one of the most primitive tribes seen. They have only temporary habitations in the forest, but are invaluable to the forestry officers because of their intimate knowledge of the jungle and its inhabitants. The more advanced Todas in the vicinity of Ootacamund were said to be rapidly dying out. The Uralis near Lake Periyar build their habitations in trees to protect themselves against the elephants. The Kannikars inhabit the malarial zones in the hills of Southern Travancore and number over 6,000, but some of them are obviously of mixed blood. The Puliyas of Travancore have somewhat negroid features and temperament. They are now much mixed, but many represent

a remnant of an original substratum in the coastal population. Many other tribes await fuller study.

The visit of the British delegation to India will undoubtedly react in many ways as a stimulus to the progress of Indian science. The most important scientific problems for India are biological. India is mainly an agricultural country of peasant villages. Her enormous and rapidly increasing population and the relatively primitive farming methods still employed render the problems of food production of prime importance in the economy of the country. Great irrigation schemes have extended agriculture over large areas which were formerly sterile. The Imperial Council for Agricultural Research was formed to stimulate the various lines of research concerned with crop production. This is done partly through grants to the numerous agricultural and plant breeding stations, for specific pieces of research bearing on the improvement and better utilization of plant crops and domestic animals.

Yet India's fundamental problem is that of population. So long as the population multiplies up to the limits of subsistence, any increase in the food supply affords only temporary improvement in the economic condition of the people. This distinctive problem of the East has yet to find a solution.

SCIENTIFIC EVENTS

AWARDS OF THE LALOR FOUNDATION

THE Board of Trustees of the Lalor Foundation have announced the selection of winners of five awards from the Lalor Foundation for research in chemistry for the academic year 1938–39. These awards comprise three fellowship grants of $2,500 each and two supplemental awards of $1,250 each. The recipients were chosen from a group of thirty-eight candidates.

The geographical areas in which the applicants received their undergraduate or advanced scientific training are represented by colleges and universities in more than twenty-four states, the District of Columbia, Canada and three foreign countries.

It is pointed out that the broad distribution of the institutions represented argues well for the public recognition of the opportunity to students of promise and ability under these awards and also indicates the wide area from which the Lalor Foundation is drawing persons desirous of achievement in the various fields of chemical research.

The recipients of the awards are:

Dr. Leland J. Haworth, of the University of Wisconsin, to continue his work with Professor F. G. Keyes in the Research Laboratory of Physical Chemistry at the Massachusetts Institute of Technology, on the fundamental properties of materials at low temperatures.

Dr. R. S. Livingston, associate professor at the University of Minnesota, to spend a sabbatical year working with Professor Frank, the Johns Hopkins University, on the study of photosensitized chemical oxidations.

Dr. Lucy Pickett, assistant professor at Mount Holyoke College, to carry on studies of absorption spectra of pure hydrocarbons with Professor Henri at the University of Liége, in Belgium, and for work at Harvard University. Dr. Pickett has also been awarded a fellowship by the Committee for the Relief of Belgium.

Dr. Walter W. Pigman, of the University of Maryland, for a year's leave of absence from his position in the Bureau of Standards in Washington, to work with Professor Helferich, of Leipzig, on the chemical nature and constitution of enzymes.

Dr. John W. Stout, of the University of California, to continue his researches with Professor Giauque on the thermal and magnetic properties of various substances at the lowest temperatures available by adiabatic magnetic cooling.

The selection committee acting for the foundation consisted of Dr. Roger Adams, director of the department of chemistry of the University of Illinois; Dr. Charles A. Kraus, of Brown University, president-elect of the American Chemical Society; Dr. Arthur B. Lamb, director of the Division of Chemistry of Harvard University, and C. L. Burdick, secretary of the Lalor Foundation.

CENTENNIAL OF THE MEDICAL COLLEGE OF VIRGINIA

THE fourth and final symposium of the series commemorating the Centennial of the Medical College of Virginia will be held on April 28, 29 and 30, with Dr. George R. Minot, professor of medicine at the Harvard Medical School and director of the Thorndike Memorial Laboratory, as the Stuart McGuire lecturer. The annual lectures are combined with the symposium this year. Other speakers on the program will be: Dr. H. E. Jordan, assistant dean of the department of medicine and professor of histology and embryology, University of Virginia; Dr. O. H. Perry Pepper, professor of medicine, University of Pennsylvania School of Medicine; Dr. Nathan Rosenthal, Mount Sinai Hospital, New York City; Dr. Alexis F. Hartmann, associate professor of pediatrics, Washington University School of Medicine; Dr. Harvey B. Stone, associate professor of surgery, the Johns Hopkins University School of Medicine; Dr. Edward D. Churchill, John Homans professor of surgery, Harvard Medical School, and Dr. Walter Bauer, associate professor and tutor in medicine, Harvard Medical School.

On the Wednesday preceding the lectures the ex-internes of the Hospital Division will have their annual meeting. A portrait of the late Dr. Manfred Call, clinical professor of medicine, will be presented to the college by the ex-internes.

The climax of the celebration will come at commencement on June 7 with a centennial program at ten thirty o'clock in the morning, with the usual commencement exercises in the evening. Dr. Henry A. Christian, Hersey professor of medicine in the Harvard Medical School, will be the chief speaker on the morning program, and J. Rion McKissick, president of the University of South Carolina, will be the speaker at the commencement exercises proper. Colleges and universities throughout the nation will be invited to send representatives for the morning program. About a hundred and forty students will be graduated on June 7 from the schools of medicine, dentistry, pharmacy and nursing.

THE EIGHTIETH BIRTHDAY OF MAX PLANCK

ON the twenty-third of April, Max Planck, originator of the quantum theory, celebrates his eightieth birthday. To him we owe the discovery of the initial clue to one of the most astonishing series of advances in the history of science. Among living physicists of the highest distinction he is the senior—a man of outstanding character, universally revered by his colleagues in every land. It is therefore fitting that we should take cognizance of the occasion and join in congratulations to him for his continued vigor.

Planck was born in 1858 in Kiel, where his father was professor of law. He attended the university at Munich to which his father had been called in 1867 and attained his doctorate at the age of twenty-one. From 1880 to 1885 he was privat-docent in physics at Munich. Thence he was called to a professorship in his native city of Kiel and after four years to become successor to Kirchhoff in Berlin.

Just a year younger than Heinrich Hertz, Planck like Hertz was to owe his advancement in part to v. Helmholtz, the outstanding figure in German physics at the beginning of Planck's career. Boltzmann was at the time actively at work in the development of the kinetic theory of matter, but his point of view still occupied a subsidiary place with respect to thermodynamics as an approach to the study of the properties of matter. So it was that Planck's first scientific interest was in the field of thermodynamics. In fact that remained his primary interest for many years and ultimately led to the discovery of the quantum. His many publications prior to 1900 deal chiefly with the clarification of the fundamental principles of thermodynamics with applications to physical chemistry and heat radiation.

Thermodynamics is a subject of maximum appeal to the conservative scientist who seeks to introduce as few special hypotheses as possible into his thinking. Planck's genius is of just this cautious type—he must find the speculations of present-day nuclear theoretical physics extremely distasteful. Nevertheless the work of Planck has led to a reformulation of the principles of physics so drastic that we can compare it only with the adoption of the Copernican view of astronomy or with the replacement of the kinematics of Newton by that of Einstein. As the Copernican system gave the key to the heavens, so the quantum theory of Planck has supplied the key to the sub-microscopic world and to the understanding of the structure of matter. On the philosophic side it has torn the law of causality from its central position as the essential basis of science and on the practical side it has provided the stimulus for a vast wealth of experiments and of experimental discoveries. The possibility that such an avalanche of change could result from the work of a conservative like Planck arose, of course, from the circumstances that the initial position of the science of physics was an unstable one.

The first of the series of researches which were to culminate in the overthrow of classical physics was apparently begun in 1894. Early in the following year Planck presented to the Berlin Academy of Science a paper on electrical resonance in which he calls attention to the harmony between his results and Kirchhoff's law relating the emission and absorption coefficients of matter for thermal radiation. Clearly he had in mind at this time the task of reconciling the electromagnetic theory of heat radiation with the demands of thermodynamics. This meant the application of the entropy concept to electromagnetic waves and the study of the equilibrium between radiation and model sources of light.

The path of progress was not a straightforward one. Planck conceived the process of establishing thermodynamic equilibrium between radiation and matter as a pure electromagnetic resonance phenomenon involving, however, an irreversible increase in entropy. The reversibility in time of the electromagnetic equations led to the same quandary here as that involved in reconciling the reversibility of the mechanical equations of motion with the entropy principle in statistical mechanics. The paradox was solved by the introduction of the postulate of a chaotic distribution of amplitudes and phases for the elementary vibrations of "natural radiation." By an analysis of the resonance phenomenon Planck was then able to derive a simple relation of proportionality between the average energy of charged linear oscillators of frequency ν and the specific intensity of radiation of the same frequency in equilibrium with these oscillators.

The ultimate goal of Planck's operations was to derive the law of the distribution of energy in the spectrum of a black body, or in the spectrum of a hollow cavity in thermal equilibrium with absorbing and emitting matter. Strange to say he made at first no application of statistical mechanics to the linear oscillators which he employed as model sources of light. Because of his thermodynamic bias he chose to treat the equilibrium between the oscillators and radiation from the point of view of entropy and so to reduce the problem to that of determining the entropy of a system of ideal linear oscillators as a function of their energy and frequency. Still adhering to the phenomenological method of thermodynamics he was able by plausible hypothesis to formulate an expression for the oscillator entropy which led to the Wien radiation formula—then the best representation of the existing experimental facts. For a moment it seemed that the problem was solved, but new experimental data showed the Wien formula to be incorrect for low frequencies and required a modification of the theory. Planck's first step was to invent a purely formal alteration in the differential equation for the oscillator entropy, thus deriving a better radiation formula—the famous one we now associate with his name. Only then did he turn to the microscopic point of view and to Boltzmann's correlation of entropy with probability in search of a genuine physical meaning for his revised entropy formula. And here Planck made the culminating discovery (1901) that the entropy expression required by radiation measurements can be reconciled with the statistical interpretation of entropy if, and only if, the possible oscillator energies are assumed to be integral multiples of a finite unit proportional to the frequency. Later investigation was to replace the proposed energy quanta by equivalent quanta of action.

When we consider how violently contradictory to every previous concept this new hypothesis was, we need not be astonished to find it practically forced upon the unwilling investigator by obdurate experimental facts. A revolutionist in spite of himself, Planck felt as keenly as any one the difficulties in his hypothesis and spent much energy during subsequent years in the effort to reconcile the quantum concept with the wave theory of light. Recognition of the existence of an element of discontinuity in the microscopic world came slowly, but doubt was followed by growing interest and after a quarter of a century of intensive research the initial difficulties of the quantum theory found their solution.

Space does not permit more than a passing mention of Planck's many other important contributions to science, to his reputation as a teacher, and to his books. He is a staunch defender of religious faith and an able and vigorous proponent of the conservative point of view with respect to the philosophy of physics. In 1913 he became rector of the University of Berlin. In 1920 he was awarded the Nobel prize in physics. To-day we acknowledge our indebtedness to his achievement and draw inspiration from the story of his disciplined life.

E. C. KEMBLE

THE FIFTIETH ANNIVERSARY OF THE AMERICAN PHYSIOLOGICAL SOCIETY

AT a banquet on the evening of April 1 at the Lord Baltimore Hotel in Baltimore, the American Physiological Society celebrated the fiftieth anniversary of its founding. The actual invitations to the organization meeting were dated December 30, 1887.

The celebration was planned by a semi-centennial committee appointed by the council consisting of Drs. Charles W. Greene, William H. Howell and Walter J. Meek, *chairman*. The celebration took the form of a special program at the annual federation banquet and the preparation of a history of the society.

At the banquet four of the five living original members were present as guests of honor: Professor R. H. Chittenden, emeritus professor of biological chemistry at Yale; Professor William H. Howell, emeritus professor of physiology at Johns Hopkins; Professor Joseph Jastrow, formerly professor of psychology at Wisconsin, and W. P. Lombard, emeritus professor of physiology at Michigan. Dr. F. W. Ellis, the fifth surviving original member, was unable to be present.

For the occasion Dr. W. T. Porter had been made honorary president by the society and he presided as toastmaster. Dr. J. J. Abel, emeritus professor of pharmacology at the Johns Hopkins University, was also a distinguished guest. Dr. W. H. Newton brought the cordial greetings of the British Physiological Society, and Dr. C. H. Best represented the Canadian Physiological Society.

The program consisted of the roll call of the original members by Dr. Walter E. Garrey, president of the society, and the introduction of Dr. Porter, the toastmaster. The introduction of the original members present followed. Eulogies of the three founders of the society were then given: Henry P. Bowditch, by Dr. Walter B. Cannon; H. Newell Martin, by Dr. William H. Howell, and Silas Weir Mitchell, by Dr. A. J. Carlson.

An account of the celebration would not be complete without a word in regard to the toastmaster and the authors of the eulogies. It is safe to say that never in the history of the society had the membership ever listened to such eloquent and finished speeches. From the literary remarks of Dr. Porter, which were filled with humor, to the vigorous words of Dr. Carlson,

who closed the program, there was not an instant when the audience did not give rapt attention. Not only was the applause in honor of the society, but it expressed the affection and admiration of all physiologists for four of the greatest scientists and characters that America has produced: Howell, Porter, Cannon and Carlson.

The semi-centennial meeting was the largest in the history of the society. It was fittingly held at Baltimore, where worked Dr. Martin, perhaps the most active of the three founders in details of its organization.

A history of the American Physiological Society from 1887 to 1937 was one of the undertakings sponsored by the semi-centennial committee. The first twenty-five years of this story has been written by Dr. Howell, an original member, an early president and one long associated with the actual workings of the society. To Dr. Charles W. Greene, long an efficient secretary and recently president, has fallen the lot to write of the period of growth which has taken place in the last twenty-five years. The history will contain the speeches made at the banquet. It will be distributed to all members during April or early May of the present year.

At the end of fifty years the American Physiological Society is more active and prosperous than ever in its history. Its achievements have been due to the spirit of its founders and the true devotion to physiological investigation as exemplified by its members.

WALTER J. MEEK
Chairman of the Semi-centennial Committee
A. C. IVY
Secretary of the American Physiological Society

RECENT DEATHS

DR. LAUNCELOT W. ANDREWS, research and consulting chemist, formerly professor of chemistry at the Iowa State University and the Iowa State College of Agriculture, died on April 14 at the age of eighty-one years.

DR. H. S. MINER, since 1888 chemist of the Welsbach Company at Gloucester City, N. J., died on April 14. He was in his seventy-fourth year.

PROFESSOR J. E. JOHANSSON, for many years professor of physiology at the Caroline Institute in Stockholm, died on March 31 at the age of seventy-six years.

PROFESSOR JOHANNES W. THIENEMANN, member of the Kaiser Wilhelm Society and curator of the Zoological Institute of the University of Königsberg, founder and formerly director of the aviary at Rossitten in East Prussia, known for his studies of the migration of birds, died on April 13 at the age of seventy-five years.

SCIENTIFIC NOTES AND NEWS

THE first civic achievement medal of the Rochester, N. Y., Municipal Museum Commission was awarded on April 12 to Professor Herman LeRoy Fairchild, professor emeritus of geology at the University of Rochester. Professor Fairchild will celebrate his eighty-eighth birthday on April 29.

THE Philadelphia County Medical Society on April 13 presented to Dr. Leonard G. Rowntree, director of the Philadelphia Institute for Medical Research of the Philadelphia General Hospital, the Dr. I. P. Strittmatter medal, awarded for "meritorious service redounding to the credit of the medical profession." The presentation of the medal and of the accompanying scroll was made by Dr. Basil R. Beltran, chairman of the award committee. Dr. Strittmatter, who founded the medal in 1923 with an endowment of $5,000, died on April 14.

THE William Wood Gerhard gold medal of the Pathological Society of Philadelphia was presented on April 14 to Dr. Warren Harmon Lewis, professor of physiological anatomy at the Johns Hopkins Medical School and research associate of the Carnegie Institution, and to Dr. Margaret R. Lewis, research associate of the Carnegie Institution. Dr. and Mrs. Lewis will deliver the annual conversational lectures on "Cultural and Cytological Characteristics of Normal and Malignant Cells." The Gerhard award was established in 1925. Its first recipient was the late Dr. William H. Welch.

AT the recent meeting of the Society of Experimental Psychologists, held at the University of North Carolina, the third annual award of the Howard Crosby Warren medal was made to Professor Elmer A. Culler, of the University of Illinois, "for his work on the fundamental mechanisms of hearing and on the physiological basis of the conditioned reflex."

AT a meeting of the Metropolitan Section of the Society of Automotive Engineers, Richard V. Rhode, of Langley Field, Va., an engineer with the National Advisory Committee on Aeronautics, was awarded on April 12 the Wright Brothers Medal, in recognition of his paper entitled "Gust Loads on Airplanes." The medal was presented at a dinner of the society after a tour had been made of the Wright Aeronautical Corporation plant at Paterson, N. J. Dr. Stephen J. Zand made the presentation.

C. B. THORNE, vice-president of the Canadian International Paper Co., has been awarded the gold medal of the Technical Association of the Pulp and Paper Industry for 1938 for "technical leadership, invention, and engineering research."

THE Council of the Royal Agricultural Society of Great Britain has awarded the society's gold medal for distinguished services to agriculture to Sir Merrik Burrell. Sir Merrik was president of the Royal Agricultural Society and chairman of the Council of Agriculture for England in 1936, and is chairman of the Agricultural Committee of the County Councils' Association. As chairman of the governors of the Royal Veterinary College he has been largely responsible for the rebuilding of the college.

Nature reports that Professor Camille Gutton, of the Ecole nationale supérieure de l'Aéronautique and the Ecole professionnelle supérieure des Postes et Télégraphes, Paris, has been elected a free academician of the Paris Academy of Sciences, in succession to the late Paul Janet.

DURING the week beginning April 18 at the Peter Bent Brigham Hospital in Boston, Dr. Emil Goetsch, first resident surgeon, now professor of surgery at the Long Island Medical College, and Dr. Francis G. Blake, first of now living resident physicians, at present Sterling professor of medicine at Yale University, served, respectively, as surgeon-in-chief, *pro tempore,* and physician-in-chief, *pro tempore.*

DR. L. H. ADAMS, since 1910 physical chemist at the Geophysical Laboratory of the Carnegie Institution of Washington, has been appointed director of the laboratory, to succeed Dr. Arthur L. Day, who retired in 1936 after serving for thirty years.

AT the University of Rochester, Dr. W. A. Noyes, Jr., of Brown University, has been appointed professor of physical chemistry. Dr. A. B. F. Duncan, also of Brown University, has been appointed assistant professor. An equipment fund adequate to initiate research in electrochemistry, discharge through gases, vapor pressures, thermal reactions and photochemistry; an annual appropriation for research, and funds to sustain seven or eight fellowships have been provided by the university. Dr. Howard S. Gardner, of the School of Chemical Engineering Practice of the Massachusetts Institute of Technology at the Eastern Manufacturing Company, Bangor, Maine, has been made head of the department of chemical engineering.

NEW appointments at the University of Alabama School of Medicine include the following: Professor of anatomy, Dr. Charles Mayo Goss, now associate professor of anatomy at the College of Physicians and Surgeons of Columbia University, to succeed Dr. Philip B. Armstrong, who has been elected head of the department of anatomy of the School of Medicine at Syracuse University; assistant professor of bacteriology and pathology, Dr. Austin Louis Joyner, now assistant in bacteriology and pathology at the Rockefeller Institute for Medical Research, to succeed Dr. H. K. Fidler, who has accepted an appointment for July 1 in surgery at the Royal Victoria Hospital in Montreal; assistant professor of physiology and pharmacology, Dr. Stuart Anderson Peoples, now assistant professor of pharmacology at the University of Louisville School of Medicine, to succeed Dr. John H. Ferguson, who resigned last year to become assistant professor of pharmacology at Michigan; instructor in physiological chemistry and medicine and assistant on the University Student Health Service, Dr. Irl Richard Long, now resident in surgery at St. Luke's Hospital in St. Louis, to succeed Dr. B. M. Miller, who is going into practice at Columbia, South Carolina.

DEAN CHARLES H. WARREN, Sterling professor of geology and chairman of the department of geological sciences at the Sheffield Scientific School of Yale University, has been appointed master of Trumbull College. He succeeds Dr. S. Bayne-Jones, professor of bacteriology in the School of Medicine and dean of the school. Dr. Bayne-Jones has been master of Trumbull College since the college was first opened in 1933.

JAMES G. MCDONALD, of the editorial staff of *The New York Times,* has been elected president of the Brooklyn Institute of Arts and Sciences.

A. T. A. DOBSON, principal assistant secretary of the Ministry of Agriculture and Fisheries, Great Britain, has been appointed Fisheries secretary in succession to H. G. Maurice, who will retire from the public service on June 30.

Engineering and Industrial Chemistry states that Floyd Miller, assistant director of research, Esso Laboratories, Elizabeth, N. J., has been appointed chairman of the subcommittee on chemistry of the Insulation Committee of the National Research Council, succeeding Kenneth S. Wyatt, who is leaving the country but who will remain a member of the committee.

M. L. WILSON, under-secretary of agriculture, has been appointed chairman of the United States delegation to the meeting of the general assembly of the International Institute of Agriculture at Rome on May 23. Other members of the delegation are: Dr. A. G. Black, chief of the Bureau of Agricultural Economics of the Department of Agriculture; L. A. Wheeler, in charge, Foreign Agricultural Service Division, Bureau of Agricultural Economics; Dr. C.

E. Kellogg, chief of the Soil Survey Division, Bureau of Chemistry and Soils, Department of Agriculture; Loyd V. Steere, agricultural attaché, Berlin; L. G. Michael, agricultural attaché, Belgrade; J. Clyde Marquis, American member of the Permanent Committee, International Institute of Agriculture, Rome; Dr. C. L. Stewart, professor of agricultural economics, University of Illinois, and Dr. John K. Galbraith, professor of economics at Harvard University. Alan S. Rogers, secretary of embassy at Rome, will be secretary of the delegation.

DR. S. A. MITCHELL, director of the Leander McCormick Observatory of the University of Virginia, gave the R. A. F. Penrose, Jr., Memorial Lecture on April 22 at the annual meeting of the American Philosophical Society. The lecture was entitled "With an Astronomer on an Eclipse Expedition."

THE James Arthur Lecture on the evolution of the human brain will be given at the American Museum of Natural History on May 5 at 8:15 P. M. by Dr. Franz Weidenreich, visiting professor of anatomy, Peiping Union Medical College, honorary director, Cenozoic Research Laboratory of the National Geological Survey of China. His subject will be "The Phylogenetic Development of the Hominid Brain and Its Connection with the Transformation of the Skull."

DR. OTIS W. CALDWELL, general secretary of the American Association for the Advancement of Science, was the principal speaker on April 15 and 16 at the second annual meeting of the southeastern biologists at the University of Georgia.

DR. G. E. M. JAUNCEY, professor of physics at Washington University, St. Louis, on April 5 gave an address on "The Vibrations and Structure of Atoms in Zinc Crystals" before the School of Mines Section of the Missouri Chapter of the Society of the Sigma Xi.

CEREMONIES installing a chapter of Sigma Xi at the Massachusetts State College were held on April 12. Professor George A. Baitsell, of Yale University, national president, directed the installation ceremony, assisted by Dean Edward Ellery, of Union College, national secretary. The main address was made by Dr. E. D. Merrill, director of the Arnold Arboretum at Harvard University. Other speakers were: Dr. Hugh P. Baker, president of the college; Fred J. Sievers, director of the Massachusetts Agricultural Experiment Station, and Dean William L. Machmer, of the college.

THE annual meeting of the Canadian Medical Association will be held at Halifax from June 20 to 24, conjointly with the Nova Scotia Medical Society. The presidential address will be given by Dr. T. H. Leggett, of Ottawa, and the Osler Lecture on "Osler, the Last Phase, and His Influence on Medicine," by Sir Humphry Rolleston. Drs. M. R. MacCharles, of Winnipeg, and William Boyd, of Toronto, will conduct a surgical clinic on cancer; Dr. J. C. Meakins, of Montreal, a medical clinic, and there will be a symposium on poliomyelitis.

DR. T. H. BISSONNETTE, professor of biology, Trinity College; Dr. W. Wedgewood Bowen, assistant professor of ornithology, Dartmouth College; Dr. Clarence C. Little, Roscoe B. Jackson Memorial Laboratory for Cancer Research; Dr. Ann Morgan, professor of zoology, Mt. Holyoke College, and Dr. Lorande L. Woodruff, professor of protozoology, Yale University, will serve as special lecturers during the eight-weeks summer session of the University of New Hampshire Marine Zoological Laboratory at the Isles of Shoals. The laboratory offers year courses for undergraduate credit in general zoology, comparative anatomy, invertebrate zoology, histology, embryology, field zoology and biology-education. There is an unusual opportunity at this station for field work in the fauna of the northern seaboard.

Nature reports that the Linnean Society of London will celebrate the one hundred and fiftieth anniversary of its foundation on May 24, 25 and 26. The president, Dr. J. Ramsbottom, will deliver an address on May 24, and on May 25 and 26 symposia on "The Concept of Species from the Time of Linnæus to the Present Day" will be held.

THE statement printed in SCIENCE and elsewhere to the effect that the Rockefeller and Carnegie Foundations would provide a large endowment for a medical center in Alabama is without basis in fact. At the request of Governor Bibb Graves, a conference was held recently in Birmingham in which the establishment of a medical center was considered. Funds, however, have not been granted for the purpose, nor have any been requested.

DISCUSSION

THE DECLINE OF INTERNATIONAL COOPERATION IN ASTRONOMY

INTERNATIONAL cooperation in science depends to a large extent upon the exchange of publications between different countries. Before the world war this exchange—in astronomy at least—was exceedingly well organized. Since 1914, however, it has never been completely normal, and the events of recent years show that the present trend is distinctly away from international cooperation.

TABLE I

ASTROPHYSICAL JOURNAL—FOREIGN SUBSCRIPTIONS

Country	Present subscribers	Number discontinued since 1931
Canada	16	3
Australia	12	1
South Africa	8	2
East Africa	1	..
Belgium	5	..
Bulgaria	..	1
Austria	3	2
Egypt	2	1
Denmark	3	3
Czechoslovakia	6	1
China	4	16
Ceylon	1	..
England	34	12
Estonia	..	1
France	16	5
Finland	1	..
Germany	48	21
Greece	..	1
India	23	2
Hungary	1	..
Netherlands	7	5
Italy	11	7
Ireland	5	2
Japan	36	33
Poland	6	4
Portugal	..	1
Palestine	1	1
Norway	1	2
New Zealand	3	1
Manchuria	1	..
Lithuania	1	1
Latvia	1	1
Korea	1	..
Jugoslavia	1	3
Java	1	..
Sweden	5	2
Siam	2	..
Scotland	7	6
Rumania	2	..
Russia	13	29
Spain	..	2
Syria	1	..
Switzerland	5	4
Turkey	..	2
Chile	1	..
Brazil	1	2
Argentina	2	3
Philippine Islands	2	..
Mexico	3	1
Cuba	1	..
Samoa	..	1
Wales	2	2

An analysis (Table 1) of recent and former mailing lists of the *Astrophysical Journal* reveals an alarming decline in foreign subscriptions. While the subscriptions in the United States in March of 1938 are practically identical with those of 1928, the foreign subscriptions have decreased by about one quarter. A breakdown by countries shows that the decline was 80 per cent. in China, nearly 70 per cent. in Russia, nearly 50 per cent. in Japan, about 40 per cent. in Italy and over 30 per cent. in Germany. Spain, Portugal, Greece and a few other countries, formerly represented by one or two subscriptions each, have dropped out completely. The decrease was relatively small in France, 24 per cent.; in England, 26 per cent.; and in the British dominions, 12 per cent. The general trend, which is shown by these figures, is so unmistakable as to arouse serious concern over the future of international cooperation in astronomy.

Since no other science depends upon universal cooperation to the same extent as does astronomy, it is quite natural that the effects of nationalistic trends in many countries are more acutely felt by the astronomers than by representatives of other sciences. During the world war, and again during the period of inflation in central Europe, many European observatories were unable to obtain American periodicals and observatory publications, and many years were required to build up the leading scientific libraries in central Europe. Immediately after the world war, the Germanistic Society of America undertook to pay for many subscriptions in Germany and Austria, and credit was extended to numerous institutions in Europe by the University of Chicago Press. It is unlikely that similar efforts will now be made on behalf of Chinese, Japanese, Russian and other scientific institutions.

Although the decline in foreign subscriptions will seriously interfere with the progress of American scientific journals, it should be pointed out that our domestic subscriptions are large enough to safeguard their existence. The *Astrophysical Journal* has in recent years been increased in size, and it has, we hope, been maintained on the same high level on which it was started by George E. Hale in 1895. At the same time the subscription price is considerably lower than that of several European journals of the same character. The problem is, therefore, not primarily concerned with the financial status of the journals. It is much more a question of maintaining the channels for the exchange of scientific information between America and other countries. It is difficult to ascertain all the causes for the decline. Financial difficulties arising from militaristic tendencies account for part of it; increased difficulties imposed by foreign governments upon the purchase of periodicals from abroad has doubtless discouraged a number of subscribers. It is to be hoped that international organizations such as the international scientific unions will take notice of this threat to international cooperation and will urge upon their members the necessity of continuing the exchange of scientific publications.

OTTO STRUVE

YERKES OBSERVATORY,
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SNOWSLIDE EROSION

A HURRIED visit was made on July 17, 1937, to the eastern base of Mount Jackson in Glacier National Park to examine the site of snowslide striations and boulders which had been noted previously.[1] A large number of new grooves were found to have been cut since the previous summer, many of which, like those seen in 1936, had retained boulders at their terminations.

Much of the higher portion of the limestone surface

[1] J. L. Dyson, *Jour. Geol.*, 45: 5, 549–557, 1937.

on which the striations and boulders occur was snow-covered in 1937. A film of melt water covering the lower surface partly obscured the striations and prevented the taking of photographs. However, the many new striations and associated boulders provided unmistakable evidence that snow sliding during the past winter had actually produced results similar to those noted the year before and then inferred to have had such an origin.

Further, many of the new grooves exhibited a characteristic not previously seen. This new type terminated in a distinctly zigzag course (Fig. 1) at the

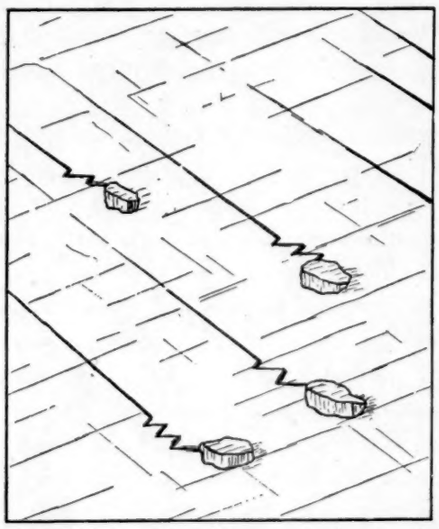

FIG. 1. Sketch of boulders and zigzag striae.

lower end adjacent to the boulder which produced it. A completely adequate explanation for such a termination has not been reached. It is presumed that the zigzags are due to sudden cessation in motion of a relatively fast-moving snowslide. This interpretation is in agreement with the writer's deductions[2] regarding the general nature of the phenomenon developed after the first study of the site.

A somewhat similar occurrence of striations has been described by Gakuro Imamura[3] from the Japanese Alps. These striations, Imamura states, are nivational in origin, new ones being formed each year. In a later paper[4] (pp. 11, 37 and 53) he mentions nivational moraines as being common and conspicuous features in the vicinity of the striations and elsewhere. From this it may be inferred that the moraines are composed, in part at least, of the materials responsible for engraving the grooves which Imamura records.

These findings of Imamura and the writer can not help but disprove the belief, still held by some, that well-defined striations on bed-rock are ultimately conclusive evidence of the former presence of glaciers.

It is hoped that among the readers of SCIENCE there may be some one who can further elucidate the zigzags.

J. L. DYSON

CORNELL UNIVERSITY

A NEW LOCALITY FOR TRYPANOSOMA CRUZI CHAGAS IN CALIFORNIA[1]

AMERICAN human trypanosomiasis is an incurable disease caused by the protozoan, *Trypanosoma cruzi* Chagas, and has been known in South America since 1909. It was discovered by Kofoid and Donat[2] in San Diego County, California, in the western cone-nose bug, *Triatoma protracta* (Uhler), and by Kofoid and Whitaker[3] in the cone-nose bug, *Triatoma uhleri* Neiva, from Tucson, Arizona.

During August, 1937, 152 *Triatoma protracta* (24 adults, 128 nymphs) were collected from woodrat nests in Eaton Canyon, between Altadena and Sierra Madre, Los Angeles County, California. Fifty-seven bugs (12 adults, 45 nymphs) or 37.5 per cent. were infected with a trypanosome.

To determine the identity of this trypanosome, two southern parasitic mice, *Peromyscus californicus insignis* Rhoads, were inoculated intramuscularly with feces from the infected bugs. Both mice were adult females, showing no protozoa in their peripheral blood before inoculation. Fresh blood examinations of one mouse showed: 5th and 7th days, negative; 9th, 6 long slender trypanosomes; 11th, 1 trypanosome; 13th, 1 trypanosome; 15th and 17th, negative; 19th, 1 trypanosome. Fecal samples of four non-infected *Triatoma protracta* (2 adults, 2 nymphs) which were fed on this mouse on the 19th day showed heavy infections with crithidias and trypanosomes 53 days later. Fresh blood examinations of the second mouse showed: 5th, 7th, and 9th days, negative; 11th, 1 trypanosome; 12th, 2 trypanosomes; 13th, negative. Fecal samples of three non-infected nymphs of *Triatoma protracta*, fed on this mouse on the 13th day, showed infections with crithidias and trypanosomes 56 days later.

On the basis of the morphology and characteristic locomotion of the living organisms in fresh mouse blood and *Triatoma* feces, their structural appearance in stained smears of feces of naturally and experimentally infected bugs, their transmissibility from infected to non-infected bugs through a mammal host, the degree of polychromasia and the differential blood picture in the infected mammal, it is concluded that this flagellate is a non-virulent form of *Trypanosoma cruzi* Chagas. These findings extend the known range

[1] The writer wishes to thank the University of California at Los Angeles for use of equipment and materials in the Department of Zoology.

[2] C. A. Kofoid and F. Donat, *Calif. and West. Med.*, 38: 245–249, 1933.

[3] C. A. Kofoid and B. G. Whitaker, *Jour. Parasit.*, 22: 259–263, 1936.

[2] *Op. cit.*, p. 556.

[3] Gakuro Imamura and Takeo Hirabayasi, *Proc. Imp. Acad. Japan*, 11: 8, 331–333, 1935.

[4] Gakuro Imamura, *Sc. Rep. Tokyo Bunrika Daigaku*, Sect. C, 2: 7, 1937.

of infected insect vectors approximately 110 miles north into the largest population center of California.

SHERWIN F. WOOD

LOS ANGELES JUNIOR COLLEGE

COMPARISON BETWEEN PRE-COLONIAL AND PRESENT-DAY OYSTERS

THE American Indian, who, prior to the sixteenth century, inhabited that area which is now the coastal region of Charleston County, South Carolina, made extensive use of *Ostrea virginica* as food. This is attested by the large number of Indian shell heaps found throughout the area. Any one familiar with the present-day oyster industry examining these shell piles immediately realizes that the size and evident quality of these pre-colonial oysters far surpassed those gathered to-day.

On the west bank of the Ashley River, about eight miles above Charleston, S. C., there is a large shell heap containing over 3,200 bushels of oyster shells. The geographic location of this shell pile is such that the oysters therein must have come from the nearby river. Practically all the oyster shells in this mound are over 3.50 inches from hinge to bill. To-day the Ashley River produces no oysters commercially, and even experimentally it is doubtful if any oysters could be gathered which would compare favorably with those from the Indian shell heap. Of course, the Ashley River is and has been for some years heavily polluted with sewage and mill waste. This pollution may have been the cause of the decrease in the size of the oysters of to-day.

In order to compare the size of pre-colonial oysters with present-day oysters in areas not affected by pollution, shells were collected from a large Indian shell heap on the edge of Sewee Bay, Charleston County, S. C. These shells came from oysters quite evidently gathered in the vicinity of Sewee Bay, which is far removed from any source of pollution. The largest individual oyster shell in this collection measured 8.00 inches long and 2.75 inches wide. Of 10 specimens selected as being the largest, the average length was 6.54 inches, with an average width of 2.56 inches. The average measurements of all specimens (50) were 4.29 inches by 2.51 inches.

From the same general locality, 290 live oysters were gathered from 15 different commercial beds. One hundred and forty of these specimens were chosen for their size, that is, the beds were carefully examined and these 140 individuals were selected as being the largest. The largest oyster in this group was 4.75 inches by 2.25 inches. The average of the group was 3.91 inches by 1.93 inches. In addition to this group, 150 oysters were gathered at random from the same beds. These were considered as being fairly representative of the oysters which could be gathered by commercial oystermen from this particular section of South Carolina. This group averaged 2.67 inches in length by 1.76 inches in width.

From these comparative measurements, the selected pre-colonial oysters were found to be 58.78 per cent. longer and 75.39 per cent. wider than selected present-day oysters. The ordinary pre-colonial oysters were found to be 62.23 per cent. longer and 76.89 per cent. wider than the ordinary present-day oysters, all of which were gathered in the vicinity of Sewee Bay.

These observations probably do not indicate that *Ostrea virginica* has become a smaller species in the past four hundred years. In all probability the small size of the present-day oyster is due entirely to intensive commercial fishing which does not allow it to reach its maximum growth.

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QUOTATIONS

THE ADVANCEMENT OF SCIENCE AND SOCIETY

DR. F. R. MOULTON, permanent secretary of the American Association for the Advancement of Science, addressed a communication to *Nature* which was printed in the issue of March 19, 1938. It reads:

Members of the American Association for the Advancement of Science have read with much interest the comments on their resolution on international cooperation of scientists which appeared in *Nature* of January 22, p. 150. As gratifying as these comments are, in one respect they differ somewhat from the spirit of the resolution.

Since I wrote the resolution and am suggesting to the Executive Committee that it extend formal invitations for an international conference of representatives of scientific societies to be held in London this coming summer, I should like the privilege of explaining the spirit of the resolution, which I believe represents the present sentiment of a large majority of the members of the American Association. By frank expressions of opinions well in advance of the contemplated conference we shall be able to make progress towards mutual understandings of possible slightly different points of view and thus prepare the way for constructive action at the conference, if it should be held.

The resolution passed by the American Association on December 30 was published in the article in *Nature* referred to above.

The preamble to the resolution consists of two distinct parts, the first of which acknowledges the profound effects of science upon society and thereby admits a heavy re-

sponsibility of men of science to their fellow men. The second part expresses the pure objectivity of science and states conditions only under which it can flourish permanently. Differing from the 1933 resolution of the American Association and from possible interpretations of the comments in *Nature*, this preamble is in no degree political or national. There is in it absolutely no note of criticism of governments or of social orders, for condemnatory words seldom lead to harmony and cooperation.

The resolution itself also consists of two parts, the first of which pertains only to the American Association. It expresses directly only what has long been a distinct policy of the association. For example, the Section on Medical Sciences is now organizing the tenth of its symposia, participated in by leading American specialists, on subjects (in this case mental health) of wide public interest and importance. Another section has held important symposia on various aspects of conservation of natural resources, while still another has made plans for five symposia on the general title "Science and Society," of which one has been held.

The second part of the resolution relates entirely to international cooperation of men of science. The invitation to cooperation is not dependent on racial, political or theological qualifications; it is open to every organization in the world the purposes of which are to spread the benefits of science to all mankind.

This sadly disordered world needs some new objective upon which it can focus its attention, some new course of procedure which it will ardently follow. It is possible that men of science can set up such an objective and gradually work out practicable methods for attaining it. Certainly, of all the conclusions that men hold, those of scientists are most easily verifiable and the methods of scientists are most easily evaluated and standardized. The verifiable nature of much of the work of scientific workers and the relative freedom of their conclusions from emotions and prejudices insures for them from the beginning a considerable amount of common ground. Possibly this common ground can be gradually enlarged until it will form a substantial basis for the general progress of civilization. Is it too much to hope that international problems of health, for example, that have been precipitated by the applications of science should be attacked and solved by scientists? Would not the altruistic spirit exhibited by science meet a compelling response in the general conscience of mankind?

Without anticipating what recommendations the American Association may desire to make respecting the purposes of the proposed conference, and not wishing to do more here than to open the question for preliminary discussions, I suggest three things that might be considered and attempted: (1) The formulation of a set of fundamental scientific principles of an ethical nature on which unanimous agreement of the delegates can be reached. (2) The formulation of the maximum number of inviolable methods of international intercourse and cooperation among scientists on which the delegates can unanimously agree. (3) The planning of the necessary machinery for making effective and enlarging the agreements reached in (1) and (2).

To the above communication P. G. H. Boswell, general treasurer, and F. T. Brooks and Allan Ferguson, general secretaries of the British Association, made a reply, which was printed in the issue of *Nature* for March 26, 1938. It reads:

We are glad to read the letter in *Nature* of March 19, under the above heading, from Dr. F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science. It need scarcely be said that the invitation from that body to the British Association to cooperate in forming the nucleus of a wider organization for this great object is engaging our earnest attention, and has already been brought to the notice of the council of the British Association. We look forward to meeting Dr. Moulton and some of his colleagues this summer, to discussing the project with them, and to having them with us at our meeting in Cambridge. It may be added in regard to the last clause in Dr. Moulton's letter concerning the "planning of the necessary machinery," that a scheme in rough outline has already been forwarded to him for informal comment, in the hope that it may prove possible, whether on the basis of that scheme or of some other, to lay practical proposals before the governing bodies of both associations at an early date.

SCIENTIFIC BOOKS

PHYSIOLOGICAL OPTICS

Introduction to Physiological Optics. By JAMES P. C. SOUTHALL. Oxford University Press, 1937.

ANY one acquainted with the author and his previous publications verifies his expectations of a creditable work on perusing this latest contribution. Professor Southall is modest in considering this an "Introduction" to the subject. It is such only in the sense that a single volume of reasonable size can not encompass all aspects of physiologic optics adequately plumbed to their depths. Some subjects, such as eyes, refraction and binocular vision, are discussed sufficiently for any general treatise. Color-vision and colorimetry are perhaps over-emphasized from an over-all view-point. Psychophysiological aspects are almost entirely ignored. In brief, the discussions are chiefly confined to certain aspects of vision and rarely touch the larger realm of seeing.

In fairness, it should be stated that Professor Southall has confined himself to the ground rules which he established in the preface. The boundaries of physiologic optics have not been established by any absolute authority and, therefore, an author may place them where he wishes for his particular purpose.

Nevertheless, a reviewer is confronted with the task of viewing a treatise in proper perspective or relation to the entire realm of which it is a part. Between the external world of visual objects and the accomplishment of seeing, and of the effects of this activity upon human behavior and welfare, lies the generally accepted realm of physiologic optics. Treatments of the latter touch so incidentally upon the external world of objects, brightnesses and colors that, with the exception of eyeglasses, the controllable factors which make seeing easy or difficult, certain or uncertain, are unduly submerged. This is also true of the human aspects and ends of seeing, for they are inadequately developed by incidental excursions into the realm of perception.

The practice of restricting the scope of treatises on physiologic optics, or of not giving at least a glimpse of the entire picture, is responsible for the widespread misconception that vision encompasses seeing. As a consequence, human beings living in a world built largely by and for seeing are paying unnecessary penalties for inadequate and improper seeing conditions, which can be corrected only by attention to seeing as well as to vision. This glimpse is not presented as a criticism but as a plea for the treatment of physiologic optics with the breadth, vitality and importance that the subject deserves as a formidable part of seeing. Other aids to seeing can be treated with the same justification as eyeglasses are. Concomitantly, glimpses are also justified of new knowledge pertaining to effects of seeing upon human beings, their performance and accomplishments, penalties and rewards. After all, vision is merely a link in a chain from the external world of visual objects to seeing and its end-products. Something can be done about vision, but much more can be done with the controllable factors in the external world which in turn greatly affect the end-products of seeing. As long as physiologic optics is treated as an isolated realm, the growth of a general understanding of seeing will be inhibited.

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THE STRUCTURE OF MATTER

Elasticity, Plasticity and Structure of Matter. By R. HOUWINK, Plastics Departments, N. V. Philips Gloeilampenfabrieken, Eindhoven, Holland, with a chapter on crystals by W. G. BURGERS. Cambridge, The University Press; New York, The Macmillan Company; 1937. Cloth, 5½ × 9 in., xviii + 376 pp., 214 fig., $6.00.

IN this work, modest in size despite the inclusiveness of its title, the author discusses the behavior of a wide variety of engineering and industrial materials under the action of stress and strain. The view-point partakes of that of the mechanical engineer, the atomic physicist and the industrial chemist, with a consequent interweaving of atomic theory and industrial test data in a most unusual manner.

In the first four chapters the author outlines the general problem of the stress-strain-time relationship of solids and viscous fluids and gives an indication of the experimental methods necessary for its investigation; then takes up the general theories of atomic and molecular structure, the solidification of matter by cooling, polymerization and the formation of gels, and the theoretical molecular strengths. There then follows, in more detailed fashion, a discussion of flow, viscosity, yield value, recovery after elastic and plastic deformation, high elasticity, rigidity and thermo-recovery.

In a fifth chapter, contributed by Dr. Burgers, the plasticity of crystals is covered in a comparatively thorough way. The stress-strain curve, strain hardening, annealing, theoretical strength and shear deformation are discussed with their relation to the crystal lattice, its deformation, its arrangement in polycrystalline aggregates and the propagation of slip through it.

The later chapters of the book cover specific classes of industrial materials, with considerable emphasis on the hypotheses of molecular arrangement, and yet with many references to industrial data and practices. Included in this treatment are the glasses, resins, asphalts, rubbers, cellulose products, proteins, doughs, paints, lacquers, clays and sulfur.

The entire work is characterized by a complete absence of dogmatism, and the reader must admire the frank way in which doubtful points are acknowledged. There is a wealth of quotations from and references to the developments of other research workers, and in fact one might almost class the book as a carefully edited symposium, or perhaps a review of current progress and thought, rather than a rigorous text or a practical exposition. In certain cases the conflicting views of different authorities are treated in such an editorial manner as to leave the lay reader not only with a feeling of respect for the open-mindedness of the author, but also with a feeling of helplessness as regards the solution of his own problem.

For the analytical philosopher specializing in any division of the field, the work should prove interesting and stimulating reading and helpful in broadening his view-point, but the student should not look to it as a text or the engineer to it as a reference book.

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FOURIER INTEGRALS

Introduction to the Theory of Fourier Integrals. By E. C. TITCHMARSH. Oxford, Clarendon Press, 1937.

THIS book is more than an introduction. Several chapters of the theory, as, for instance, the theory of special (Plancherel, Hilbert) and general (Watson) transforms and of self-reciprocal functions—to which the author contributed substantially—are presented in full and are an excellent basis for further research in modern topics of Fourier analysis.

The book includes a great number of formulas and formal relations; formulas of the classical type as may be found in Burkhardt's article in the "Encyclopädie der mathematischen Wissenschaften"; formulas concerning Bessel functions and Gamma functions; and formal relations underlying modern theories of transforms. Problems of convergence and summability for the ordinary Fourier integrals and for related integrals are treated with great care in a very satisfactory way. Even Perron's formula for the coefficients of Dirichlet's series is included. The theory of transforms for different L-classes is also presented with much detail. But neither here nor anywhere else does the author introduce general Banach spaces and its operations.

Fourier-Stieltjes integrals are omitted completely. The omission will be felt not only by the analyst but also by the student of applied mathematics who, if properly equipped, can profit greatly from this treatise. The last two chapters are devoted to applications of the theory to the solution of differential and difference equations and of integral equations. They are written in a masterly fashion, combining the classical ease and flexibility of the formal set-up with a rigor which is unprecedented in standard works on the topic and yet does not weigh down heavily on the reader.

S. BOCHNER

SPECIAL ARTICLES

A PYOGENIC VIRUS IN THE RAT

WE have recently encountered in the white rat an agent closely resembling the known viruses except that it causes extensive necrosis and pus formation in the subcutaneous tissues.

In a number of experiments where rat sarcoma 39 had been mixed before inoculation with various organs of the rat, or with adsorbents employed to remove an antibody from tissue extracts, or had been incubated in such extracts or in Locke's solution, abscesses sometimes arose at the inoculation site, even though all materials had been proved sterile before use. No such occurrence has ever been observed during some twenty years' routine propagation of this growth, suppuration having been restricted to experiments where the sarcoma was treated in some way before implantation. Hence there is no evidence that the agent in question bears any relation to this neoplasm other than that of a chance contaminant, though why it should become manifest only under the conditions just recited we are quite unable to explain.

When aerobic and anaerobic cultures from these abscesses proved consistently sterile on a wide variety of media, and smears of the pus stained in several different ways revealed no organisms of any sort, the suspicion of a virus had to be entertained, though we knew of none whose activities were so eminently pyogenic.

It was found that the agent can be transferred by 10 per cent. extracts in physiological saline or Locke's solution, will pass a Berkefeld W filter, resist drying and retain its viability fairly well for at least seven days at room temperature or for twenty-one days in the ice-box. It remains active in 50 per cent glycerol-saline for at least a month in the ice-box, and withstands exposure for one hour to 56° C. but not to 60° C. It is killed, also, by 0.05 per cent. formol over night at room temperature but unharmed by two days' contact with 0.05 per cent. phenol in the ice-box. Ultra-violet light for one minute leaves it undamaged but abolishes its activity after fifteen minutes.

When 0.05 cc of a 10 per cent. extract of pus and abscess-wall are injected subcutaneously into a white rat of the breed used at the Crocker Institute there ensues a vigorous proliferation of the connective tissue accompanied by necrosis and pus formation until, by the third or fourth day, the process is indistinguishable from any bacterial abscess. At this stage the lesion may be as large as 5×1 cm, the excess of length over width resulting from the use of a long inoculating needle and flowing of the injected fluid back along its path. The overlying skin is moderately reddened, the surrounding connective tissue intensely congested, and the abscess-wall thick and fibrous. As time goes on more and more pus collects, the fibrous process recedes until the lesion has become a mere thin-walled pus sac, and cure is accomplished in about seven days if the abscess opens on the surface, as it often does, or after several weeks when it is absorbed without rupture.

If there is any constitutional disturbance it can not be very severe, for the animals retain a glossy coat, eat normally, do not lose weight, and none die. There does take place, however, a definite increase in the proportion of circulating polymorphonuclear leuco-

ytes, which sets in immediately after injection and sts for about three days.

After the process has run its course the animal resists second inoculation.

In affected rats the agent has been found in the mph nodes, which readily transmit the disease, rarely the spleen, and not yet in the heart's blood.

The testis is especially vulnerable, for the introduction of 0.2 cc of a 1:10,000 dilution of the original 0 per cent. extract into this organ has resulted in total destruction by suppuration.

Intraperitoneal injection causes an occasional abscess the abdominal cavity, as, for example, in the gastrosplenic omentum, but no generalized peritonitis or noticeable disturbance of health.

After intravenous inoculation the results are more erious. Within three days the feet often become dematous and reddened and in such an event abscesses re prone to develop there a few days later. By then he rats are obviously ill and lose weight rapidly, though how much of their emaciation is due to the disease itself and how much to the starvation entailed by their difficulty in obtaining food has not yet been determined.

In addition to this predilection for the feet this gent has the curious property, after introduction nto the blood-stream or the testis, of frequently eliciting an abscess in the suprascapular region on one side or both. Such a localization is difficult to explain, for no lymph node occupies this site in the rat.

The agent has now undergone eight passages in the subcutaneous tissue of the rat with no diminution in virulence, and was transmitted for six in the mouse brain, though with some loss of infectivity for the rat at the end of the series. Mice that have been intracerebrally inoculated almost invariably die after from three to eight days with edema of the skin overlying the head and a mild degree of meningitis.

The rabbit is partially refractory and the guinea-pig almost completely so.

The agent is now in its sixth passage in the chorioallantoic membrane of the chick. After the third it was tested in the mouse brain and the subcutaneous tissue of the rat, and found to display its customary activity.

Having found in the literature no account of this disease or of any resembling it we submit this brief report, which will be followed in due course by a more complete description.

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THE INHIBITORY EFFECT OF OXIDIZED ADRENALIN

IN a recent paper from this laboratory (Lissak and Morison, in press) evidence is presented that 933F (piperidino-methyl-3-benzodioxane) increases the rate of oxidation of adrenalin *in vitro* and *in vivo*. In the course of this experiment it was observed that if oxygen or air was bubbled through an adrenal in solution (1:100,000) after one to two days it lost its positive effect on the frog heart and had a negative, inhibitory effect. In order to test further this negative inhibitory effect of oxidized adrenalin, different dilutions of adrenalin (Parke, Davis) were made with standard Ringer's solution. Through these adrenalin solutions oxygen was bubbled at room temperature one to four days. The evaporation of water from the solutions was compensated for by adding distilled water to restore the original volume. When tested on isolated hearts of winter frogs, according to the method of Straub, the adrenalin solution (1:100,000), treated as described above for 72 hours, has a negative inotropic and sometimes a negative chronotropic effect. The negative effect was not completely inhibited by atropine (1:50,000).

During the course of my experiments papers were published by Heirman[1] and by Bacq.[2] They have shown that oxidizing adrenalin with phenolase (tyrosinase, catecholoxidase) a substance "adrenoxine" appears, which has a negative, inhibitory effect on the frog heart and blood pressure of the cat and the rabbit, *i.e.*, the same effect as described above.

Furthermore, Bacq concluded that the non-pregnant uterus of the cat contains a catecholoxidase, which after 45 to 90 minutes transforms adrenalin into inhibitory "adrenoxine," and that the presence of this phenolase "undoubtedly" determines the inhibitory reaction of the non-pregnant uterus to adrenalin. Since Bacq did not report control experiments it seemed desirable to repeat his procedures with properly controlled tests. On doing so, using exactly his method, I found no evidence that extracts of either the pregnant or the non-pregnant uterus of the cat contain a ferment which destroys or transforms adrenalin, but that actually such extracts check adrenalin destruction. Apparently this is because the tissues contain an inhibitor which is very efficient in protecting adrenalin from auto-oxidation.[3, 4, 5, 6] Adrenalin, when mixed with extracts of the feline non-pregnant uterus, will produce, even after 3 to 4 days, typical reactions:

[1] P. Heirman, *Compt. rend. Soc. de Biol.*, 124: 1250, 1937a; *ibid.*, 126: 1264, 1937b; *ibid.*, 127: 343, 1938.
[2] Z. M. Bacq, *Compt. rend. Soc. de Biol.*, 127: 341, 1938.
[3] R. D. H. Heard and A. DeM. Welch, *Biochem. Jour.*, 29: 998, 1935.
[4] A. Láng, *Ber. ges. Physiol.*, 101: 675, 1937.
[5] A. DeM. Welch, *Am. Jour. Physiol.*, 108: 360, 1934.
[6] M. O. P. Wiltshire, *Jour. Physiol.*, 72: 88, 1931.

increase of blood pressure of the cat, more rapid contractions of the isolated frog heart, relaxation of the isolated non-pregnant uterus and contraction of the pregnant uterus of the cat. Control tests showed that extracts of the feline uterus alone, not mixed with adrenalin, decrease the blood pressure.

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THE MOLECULAR WEIGHTS OF ANTIBODIES

IT was shown by Heidelberger and Pedersen[1] that certain antibodies formed by the horse and the rabbit differed markedly in sedimentation constants and therefore probably also in size. It is of importance, therefore, to make accurate determinations of the molecular weights of these substances and also of the antibodies formed in other animal species.

Types I and III antipneumococcus sera from the horse, rabbit, pig, cow and monkey were used. The antibodies were purified by dissociation with 15 per cent. sodium chloride of the washed specific precipitate or agglutinate formed by adding type specific polysaccharide[2] or a heavy suspension of heat-killed pneumococci. Several of the antibody solutions used were prepared especially for this investigation by Dr. Michael Heidelberger, of the Presbyterian Hospital, New York. The 15 per cent. salt extracts were dialyzed against 0.9 per cent. NaCl and the sedimentation (s) and diffusion (D) constants determined.[3,4] From these values the molecular weights were calculated according to the formula given by Svedberg:

$$M = \frac{RTs}{D(1-V\rho)}$$

Determinations of the partial specific volume for horse antibody gave $V = 0.715$, which was also assumed to be valid for bovine and pig antibody. The value for normal globulin $V = 0.745$, was used in calculating the molecular weights of rabbit and monkey antibody. Table I shows the average sedimentation constants, diffusion constants and molecular weights of the various antibodies. In the last column are given the ratios between the experimentally determined molar frictional constant and the molar frictional constant for a spherical particle of the same mass and density.

TABLE 1

Species	$s_{20} \times 10^{13}$	$D_{20} \times 10^{7}$	M	f/f_0
Pig	18.0	1.64	930 000	2.0
Cow	18.1	1.69	910 000	2.0
Horse ...	17.9	1.63	930 000	2.0
Rabbit ...	7.0	4.23	157 000	1.4
Monkey ..	6.7	4.06	157 000	1.5

The high value for the frictional ratio f/f_0 would indicate that the heavy antibody molecule is neither compact nor spherical, as $f/f_0 = 1$ is obtained only when the molecule is spherical and unhydrated.

The proportion of antibody N to total N in the solutions ranged from 40 to 100 per cent. In each case, however, it was possible to obtain solutions showing only a single component with the sedimentation constant in the table. (A very small amount of a heavy component was found in the monkey antibody preparation).

The sedimentation constant was also measured in the 15 per cent. salt solution used for dissociation and found to be the same as after dialysis, indicating that the purification process had not altered the ultracentrifugal properties of the antibody.

In a horse antiserum and a pig antibody solution (each containing two components, $s = 6.7$ and 18.7×10^{-13}) it was possible to demonstrate that the heavy component was the bearer of the antibody activity by using the new analytical cell described in *Nature*.[5] After centrifuging the heavy component into the lower compartment no antibody could be detected in the upper compartment. When the heavy component was centrifuged so that the boundary was only part of the way down, antibody still remained in the upper compartment.

The results indicate that there are two definite groups of animals, one usually producing antibody of the same size as the heavy component frequently observed in normal mammalian sera, and the other forming antibody of the same size as the principal globulin component of normal sera.

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VITAMIN L

THE specific dietary factor for lactation and vitamin B complex had long been confused, and it was not until 1934 that the two were clearly distinguished and the existence of the lactation factor established.[1] Since

[1] M. Heidelberger and K. O. Pedersen, *Jour. Exp. Med.*, 65: 393, 1937.
[2] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 64: 161, 1936; M. Heidelberger and E. A. Kabat, *Jour. Exp. Med.*, 67: 181, 1938.
[3] For a review see The Svedberg, *Chem. Rev.*, 20: 81, 1937; *Nature*, 139: 1051, 1937.
[4] O. Lamm and A. Polson, *Biochem. Jour.*, 30: 528, 1936.
[5] A. Tiselius, K. O. Pedersen and The Svedberg, *Nature*, 140: 848, 1937.
[1] W. Nakahara, F. Inukai and S. Kato, *Proc. Imp. Acad.*, Japan, 10: 268, 1934; *Sci. Pap. Phys. Chem. Research*, Tokyo, 24: 155, 1934.

at time our knowledge on the subject has been greatly tended, and it now appears that this lactation factor ay well be considered as a new vitamin.[2,3]

A diet can be formulated which is entirely adequate cept for lactation. We found, for example, a mixre of polished rice powder, 75 gr, fish protein, 10 gr, tter, 10 gr, McCollum's salt mixture, 5 gr, adequately pplemented with acid earth adsorbate of yeast exact (vitamin B complex), to be just such a diet. On is diet, in spite of the excellent growth of young ts, normal pregnancy and parturition, rats fail to ar the young at the first as well as at the second rths.

In order to secure normal lactation, two hitherto identified substances must be added to the diet, mely, factor L_1 and factor L_2. That these two are fferent substances was proved by the fact that a large mount of the one can not substitute for the other. he two factors are equally essential in that one is ithout effect in the absence of the other.

We separated factor L_1 from beef liver extract by moving vitamin B complex by adsorption on acid rth at pH 3–4, precipitating from the non-adsorbble fraction with $Ba(OH)_2$ and methanol, removing ater-soluble matter (glycogen) from the precipitate, nd finally precipitating from the aqueous solution ith $WO_3.2H_3PO_4$. This crude preparation proved tive in the estimated daily amounts of less than 50 g per rat.

Factor L_2 was obtained from baker's yeast by similarly removing from the extract vitamin B complex by adsorption on acid earth, precipitating from the filtrate with $WO_3.2H_3PO_4$ and again with $AgNO_3$ and $Ba(OH)_2$. This preparation was effective in daily amounts of 15 mg per rat.

Beef liver does not contain factor L_2, while baker's yeast seems to be devoid of factor L_1.

The exact physiological role of L-factors is as yet far from being clear, but we recently found that if the lactation mechanism is established at the first birth in the presence of L-factors, these latter are no longer needed for the second lactation in so large an amount as is absolutely necessary for the first lactation. It may be that these factors have specific relation to the first establishment or maturation of the lactation mechanism.

From the point of view of nutritional study, the lactation factors in question must be regarded as vitamins, since there is no doubt that animals depend entirely on dietary supply for the substances, which we know must be effective in very minute amounts. We, therefore, propose to call them vitamin L_1 and vitamin L_2, together constituting vitamin L complex.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE VIVI-DIFFUSION APPARATUS

A VIVI-DIFFUSION apparatus which has been found tisfactory for the rapid removal of non-protein itrogen from the circulating blood is shown in Fig. 1. n contrast to the vivi-diffuser described by Abel and nd coworkers[1] this apparatus (a) uses a ready-made embrane, (b) is simple in design, (c) has provision r the stirring of the dialyzing fluid and (d) is quipped with a constant temperature mechanism.

A metal can (36×30 cm) contains a hollow, eighted, removable, spiralled core (31×20 cm) on hich is wound 20 feet of ¾ inch size Visking sausage sing.[2] This length of casing holds approximately 00 cc of blood. The ends of the casing are moistened and fitted over glass tubes, A and V, tied with light cord, and are then clamped with rubber-lined clamps (C). Tubes A and V are sealed into the can by means of rubber stoppers. Tube A is connected by means of rubber tubing to the arterial canula; tube B is similarly connected to the venous canula.

An electric heater (H), a thermostat (T) and an electric stirrer (N) are fitted in the can cover. These devices are so constructed that they can be dropped into place after the cover has been attached to the can.

The dialyzing fluid consists of 0.7 per cent. sodium chloride solution (14 liters) kept at a temperature of 38° C. During operation the venous end of the membrane is kept at the same level as the venous canula.

Normal and nephrectomized dogs anesthetized with nembutal were used to test the efficiency of the apparatus in removal of non-protein nitrogen compounds from the blood. Heparin was used as an anti-coagulant. Blood was taken from the carotid artery and returned to the jugular vein. When small dogs were

[2] W. Nakahara, F. Inukai, S. Kato and S. Ugami, *Sci. ap. Inst. Phys. Chem Research*, 29: 47, 1936.
[3] W. Nakahara, F. Inukai and S. Ugami, *Proc. Imp. ead.*, 11: 362, 1935; 12: 289, 1936; *Sci. Pap. Inst. Phys. hem. Research*, 28: 31, 1935: 31: 42, 1937.
[1] J. J. Abel, L. G. Rowntree and B. B. Turner, *Jour. harmacol. and Exp. Therap.*, 5: 275–316, 1914.
[2] From the Visking Corporation, 4311 Justine St., Chigo, Ill.

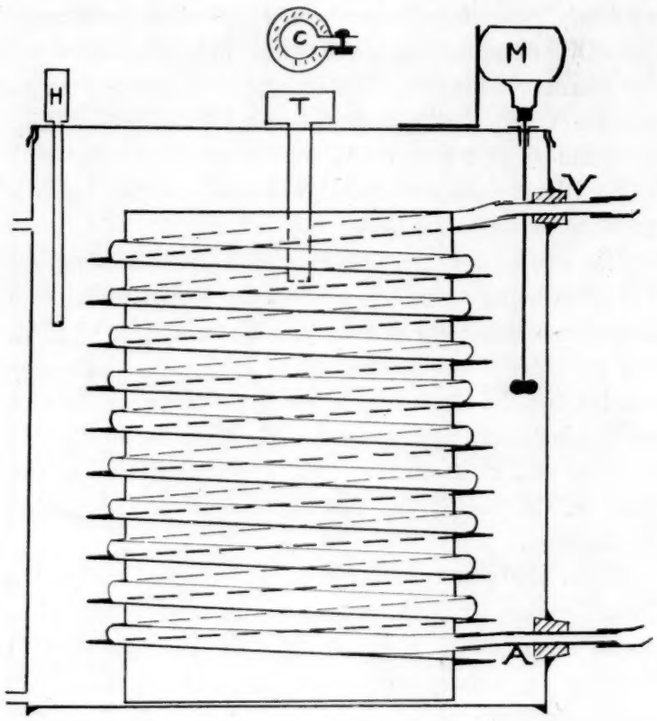

FIG. 1.

used the apparatus was first filled with blood taken from another dog. With dogs weighing 20 kilos or more this was not done. Typical results obtained are shown in Table 1.

TABLE 1

Expt. No.	Blood level at start mg/100 cc		Grams removed in two hours	
	Urea nitrogen	Non-protein nitrogen	Urea nitrogen	Non-protein nitrogen
(1) Nephrectomized ..	237	270	3.74	4.11
(2) Nephrectomized ..	203	255	3.26	3.62
(3) Normal ..	14	22	0.23	0.31
(4) " ..	12	27	0.24	0.34

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LUCITE NOT A SUBSTITUTE FOR CANADA BALSAM WHEN MOUNTING MICROSCOPE SLIDES[1]

LUCITE[2] is a crystal-clear methyl methacrylate polymere which has a refractive index nearly the same as glass and is readily soluble in dioxan. Dioxan[3] has proven useful as a dehydrating agent for the preparation of sections and objects to be mounted for observation with the microscope. Thus with the Lucite in dioxan solution it should be possible to mount the preparations as soon as they are dehydrated. In fact, the Lucite hardens rapidly and the mounts are enough for use in about an hour after they are mou on a slide under a cover glass. After a time the L dries and contracts and draws air bubble channels u the cover glass. When no cover glass is used, suc ful, stained smear preparations have been made.[4] own preparations, mounted in Lucite dissolved in tone, amyl acetic, ethyl acetate or dioxan with no c glass, show much less fading at the end of five mo than those mounted under a cover glass.

Unfortunately, the Lucite dissolved in di bleaches many of the more important stains use microscopy which, in the order of least faded to c pletely faded, are the following: basic fuchsin, me lene blue, eosin, Heidenhain's iron haematoxylin, lich's haematoxylin, acid fuchsin and light green aqueous solutions or standard formulae). Dissol the Lucite in other solvents (acetone, amyl ace ethyl acetate) did not prevent the fading. The colorizing of the stained sections takes place in f a few days to five months. Furthermore, the sect are less well cleared than they are in balsam or da Clearing is very poor also when the sections mounted with no cover glass, but the use of an mersion oil then clears the sections fairly well.

Lucite is unsatisfactory as a mounting medium microscope slides for other than temporary use, cause the Lucite decolorizes the stained sections in drying forms air-bubble channels which spoil preparation mechanically. When no cover glass used the fading is much less rapid.

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[1] From the Marine Biological Laboratory, Chemical Room.

[2] Formerly called Pontalite; manufactured by du Pont.

[3] H. W. Mossman, *Stain Tech.*, 12: 147, 1937.

[4] B. F. Skiles and C. E. Georgi, SCIENCE, 85: 367, 19

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